THE MODEL ENGINEER

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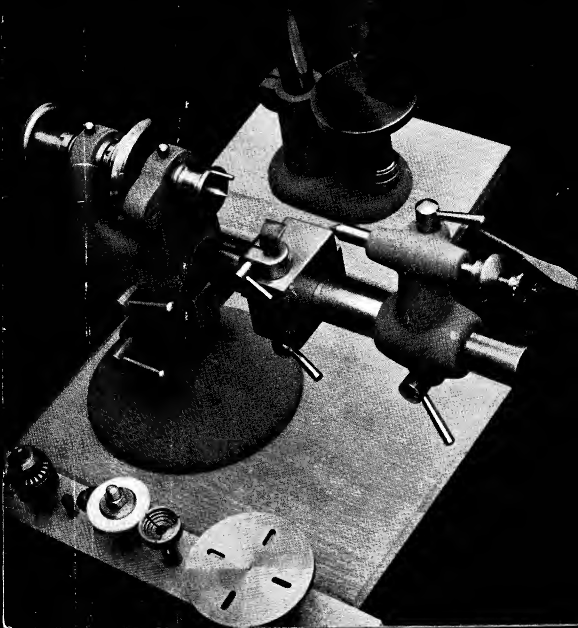


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

9TH SEPTEMBER 1948 VOL. 99. NO. 2468

SMOKE RINGS

Our Cover Picture

● FROM THE many interesting exhibits in the International Section at the Exhibition, this jeweller's lathe, of approximately $1\frac{1}{2}$ in. centre height, and sensitive drilling machine with accessories have been selected this week. They are the work of Mr. O. Lindqvist of Sweden. The structural castings which are beautifully finished in grey crackle enamel indicate that Mr. Lindqvist has succeeded in overcoming the difficulties which seem to beset many model-makers in this country who attempt to produce this effect. Perhaps some reader who has succeeded will let us into the secret.—P.D.

Club Stands at the Exhibition

● I FIND it difficult to express in a few words my impression of this year's MODEL ENGINEER Exhibition. If I say it was the best ever held, there may be those who will say to themselves "that is exactly what they said about last year's exhibition." Nevertheless, it is true; each succeeding year sees the quality of the exhibits improve where further improvement was thought impossible.

The clubs, too, excelled themselves, and I would like to thank them for the enjoyment I experienced in studying the many magnificent exhibits with which they filled their stands.

I found the demonstrations of radio control on the Radio Controlled Model Society's stand and that of The Low Speed Aerodynamic Research Association most impressive. I believe that with a rising generation of electronic engineers, great possibilities lie ahead in this branch of model-making. I also derived much satisfaction in watching the action of the many fine models driven by compressed air. This scheme, in my opinion, added considerably to visitors' enjoyment of the exhibits; it certainly did to mine.
—P.D.

Well Done!

● I DO not think that anybody could have the least doubt as to which of the many splendid locomotives in this year's "M.E." Exhibition would win the Cup. But to Mr. George Dow,

Mr. F. C. Hambleton and me, who had to judge it, the problem was not so easy; there was a very severe handicap imposed upon the engine, in that its builder, Mr. Powell of Crewe, by reason of his occupation in the famous locomotive works there, had an advantage not shared by the other competitors, and also he did not paint the model. But even after due allowance had been made for these two facts, the sheer merit of the job was more than sufficient to justify the award. Now I want to see *Duchess of Buccleuch* in steam; and I think she would emulate her prototype without difficulty.

Three other entries which ran the "Duchess" a very close second, so to speak, Mr. Hollings's L.M.S. Dock-tank, Mr. Crowther's "Belinda," both for $7\frac{1}{4}$-in. gauge, and Mr. Cottam's $3\frac{1}{2}$-in. gauge G.W.R. "King," were all outstanding examples of meticulously accurate model-making. I cannot recall a previous occasion when there have been seen together so many miniature locomotives possessing so few faults, singly or collectively. I hope that each of the prize-winners will let readers have his own description of his work.—J.N.M.

Model Engineers Never Grow Old!

● SOME SECTIONS of the public, including the lay press, seem to find it very difficult to form a proper appreciation of the mentality of the model engineer, and are amazed to find that nearly all the active participators in this hobby are people of mature years, rather than adolescents or juveniles. One remark that was heard during the "M.E." Exhibition was possibly intended to be mildly derisive; it was to the effect that a man whose pet obsession is in small models must have a "scale model mentality." It would perhaps be more correct to say that model engineers have a young mentality—a "Peter Pan" complex—with the result that their minds never grow old. In order to build models, or even to take an interest in them, one must have a keen intelligence, which is not at all in keeping with an infantile or immature mind; but the mentality which refuses to admit that models are something more than mere playthings must surely be on the way to senility.—E.T.W.

Better Models Than Ever!

● THE OFT-EXPRESSED fallacy that craftsmanship is slowly but surely dying out was effectively dispelled by the examination of the models displayed at THE MODEL ENGINEER Exhibition, the quality of which progresses steadily every year, and reached the highest level yet attained in the 1948 Exhibition.

One of the most significant comments which I heard on the opening day was that made by a professional engineer of many years' experience in high-class precision work. He expressed the opinion that the resourcefulness of the model engineers of today, in tackling the most difficult problems with equipment which a professional would dismiss as totally inadequate, is the shining feature of the Exhibition; and that the future generation of craftsmen would have to be recruited mainly from the enthusiasts who do this sort of thing for the sheer love of it, rather than regarding engineering as simply a means of livelihood, or even as a career.—E.T.W.

The Thrills of the Circular Track

● FROM THE many comments of visitors to the exhibition, and also by the dense crowd which always surrounded the track when demonstrations were being given, it is quite evident that this feature was among the most popular attractions of the exhibition. It has, once again, brought home to the general public the remarkable performances which can be obtained with the various types of models, and there was hardly a dull moment during any of the demonstrations. Motorists and motor-cyclists who have followed racing events for very many years said that the speed thrills on the model track equal anything that they have ever seen in full-size racing, and stunt pilots of the R.A.F. could find something to marvel at in the spectacular feats of the model aircraft. The model power boats, though perhaps somewhat less spectacular than the other types of models, were none the less fully appreciated. The "prototype" boats not only gave an exhibition of realism, but also afforded splendid opportunity for observation of their detail work as they cruised around the tank, while the model racing hydroplanes demonstrated the way in which very diverse types of experimental hulls can all produce a high performance, and retain stability in very disturbed water. This feature is only in its second year, but it shows signs of influencing the design, and no less, the scope of power-driven models of all types, including the possibilities of jet propulsion, as demonstrated by the "Jetex" propelled models.—E.T.W.

Reflections on the Exhibition

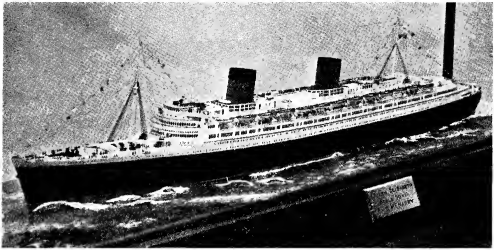
● ONE OF the nicest things about THE MODEL ENGINEER Exhibition is the opportunity it affords of meeting old friends and of making new ones. It is *the* opportunity of the year for people of similar interests to foregather, and it is easy, by watching the reaction of the visitor to the different types of models on view, to detect what is his particular interest. A quiet word usually leads to a very interesting discussion and in a moment or two a contact is made which might easily develop into a lifelong friendship. The discussion usually furnishes one with new ideas and new methods of overcoming difficulties, and in addition, gives one the opportunity of helping the visitor overcome *his* difficulties. The question of the awards invariably crops up, and much may be learnt by the comparison of the models which have received awards. One's own ideas are frequently at variance with those of the judges, but the exercise of one's critical faculties is always beneficial. I remember in an art school years ago, the master bemoaning the stupidity of the students who had not formed the habit, or were incapable, of criticising their own work. Even apart from the ideas and enlightenment to be obtained by comparing prize-winning models, much may be learnt by merely studying other peoples' work. The club member does not feel the need of this so much, but to the lone hand, the opportunity afforded by the Exhibition is invaluable.—E.B.

Ship Models at the Exhibition

by E. Bowness

THE number of ship models entered in the Competition Section at the recent MODEL ENGINEER Exhibition was 25 per cent. greater than the total for the 1947 exhibition. The standard of workmanship, speaking generally, shows considerable improvement. True, there was no sailing ship model as good as Mr. Alderson's *Norman Court*, which won the Championship Cup last year, but that was an exceptional model, and it may be years before we see its equal. As is usually the case, there were one or two models which were definitely below the standard, and which were out of place in such company. This is always a problem, and if we are to keep the competition open to all, it is difficult to see what we can do about it. Really, it lies with the competitor; even if he is a lone hand, and, perhaps, has never been to a model engineering exhibition, he should remember that THE MODEL ENGINEER Exhibition contains most of the best models of the year. If in doubt, he could enter his model at a local exhibition and see how it compares with the models shown, before sending it to the premier exhibition.

Curiously enough, the miniature section has fewer entries this year than last, but this was more than made up for by the all-round increase in the other sections. This was probably the reason why the Championship Cup for steamers went to a large working model. Mr. McNarry's *Queen Elizabeth* was quite equal to his *Stirling Castle*, which won last year's cup, but the problems involved in producing a large working model, such as the river pilot boat, by R. Fletcher, are considerably more complex than those involved in producing a miniature, and this has to be taken into account when judging. This particular model was a superb example of boat building, being planked on a very fine frame, and in addition, the power plant, a 2-cylinder internal combustion engine, was beautifully made and installed. Usually, either the boat or the engine is a little lacking in quality of workmanship. Speaking of Mr. McNarry's *Queen Elizabeth*, it was interesting to compare his " sea " with that of a similar model, but of the *Queen Mary*, by Mr. Burrage, which won an award in the 1946 exhibition, and which was displayed this year on the Malden Society's stand. Mr. McNarry's model has a sea which is quite appropriate, assuming that the ship is sailing at a moderate speed, whereas in Mr. Burrage's model, the bow wave is much more pronounced, the wake wider and more turbulent, and the secondary waves along the side of the ship are well in evidence. The sea in Mr. Burrage's model gives a tremendous feeling of the surge created by a great ship when at speed.

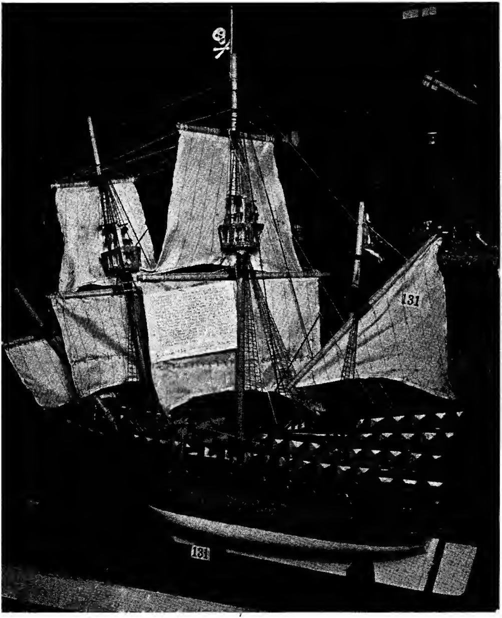


D. McNarry's model of the " Queen Elizabeth "

There were two examples of the cargo-passenger liner *Penang*, described in our pages during 1947, and also a model of the destroyer *Javelin*, described in the " Ship Modeller's Corner " during 1944. This latter is a very nice model, the hull and superstructure being a good example of clean metal-work. The hull is built of T-frames with the strakes of plates correctly laid. The builder tells me that the weight, complete, works out at 36 lb., and that she requires approximately 6 lb. of internal ballast to bring her down to the correct water-line. I have seen her in

action and she performs very satisfactorily, both as regards speed and stability.

The cup winner in the Sailing Ship Section, Mr. Honey's model of Amundsen's jagt *Gjoa*, was one of those rare ship models in which it is almost impossible to find a defect. The only thing we saw to criticise was the slight roughness amidships on the starboard side of the white strake between the two wales or rubbing-strakes. Otherwise everything seemed perfect. The easy lines of the hull, the nice set of the sails, the cord used for the rigging (this was probably made by the builder himself), the clean detail work on the deck fittings, and the general "shippiness" of the whole thing were a delight to the eye. Mr. D. C. Ray's model of the Yorkshire coble *Eliza*, which was awarded a bronze medal, had many of the qualities of the



C. V. Thompson's sailing model galleon

cup-winning model, especially with regard to its sails and rigging. The clinker-built hull, also, was a beautiful example of careful craftsmanship.

Another notable model was Dr. Rowland's *Brynhilda*, of which mention has already been made. Practically every external detail was included, and the workmanship was superb. But for one or two small points which could have been avoided by a little more care and attention, this model might have won the cup. Dr. Rowland's cup-winning model of the 4-masted barque *Glaucus* will be remembered by many of our readers. Among the many galleons, of which the quality varied from very good to indifferent, the one we illustrate this week attracted our attention. The workmanship is rather rough, but this is largely due to the fact that it was made as a working model with a view to trying out the possibilities of this type on the water. The hull is big enough to carry the sails which, it will be seen, are smaller than is usual in this type of model. The model is probably much nearer the proportions of the actual ship than is usual with this type.

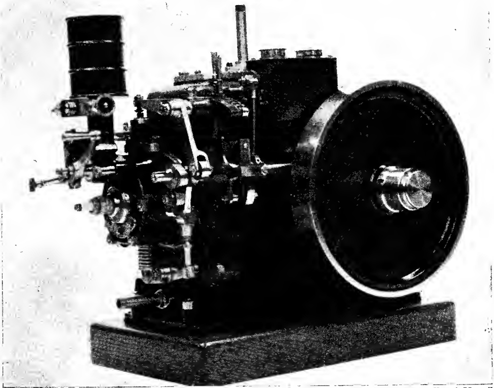
When describing the models from abroad last week, we omitted to mention the chessboard exhibit from Sweden. The chessmen were tiny models of ships and were most exquisitely finished. We hope to reproduce close-up photographs of some of these in a future issue.

The Internal Combustion Engines

by Edgar T. Westbury

PROGRESS in both design and workmanship of the models in this section has been fully maintained in the present exhibition. The small number of exhibits in this section was an occasion for comment last year, and I am very glad to note that the numbers in this year's exhibition were much more representative of the general popularity of i.c. engine models. The variety also has been highly satisfactory, and examples of both 4-stroke and 2-stroke engines, air-cooled and water-cooled types, single and multi-cylinder, were all featured.

The Ensign 10-c.c. 2-stroke, described in

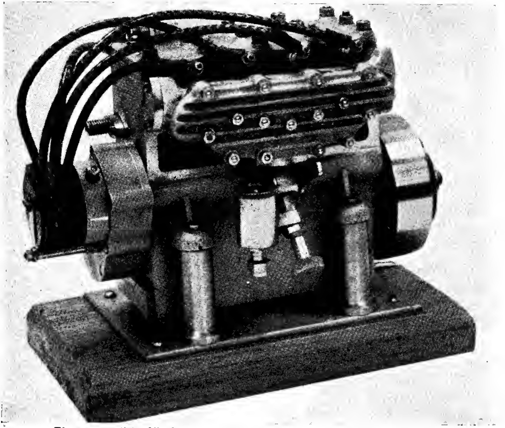


An adaptation of the "M.E." road roller engine for stationary use by R. L. A. Bell, of Yeovil

The Model Car News was represented by two engines in the i.c. engine competition class, namely No. 197 by R. Figg, of N. Harrow, and No. 394 by J. C. Hibberd, of Wilford, Notts, and no less than four fitted to model racing cars, all of them quite well built, and in conformity with the specified design.

case, and returns it to the reservoir of the pump.

Another interesting addition to the engine is a very ingenious governor gear, comprising a centrifugal governor, very cunningly built into the flywheel and operating, through the usual rods and multiplying levers, a barrel throttle inside the hand-operated throttle, which is of



The 15-c.c. "Seal" four-cylinder engine by G. Cheverton, of St. Albans

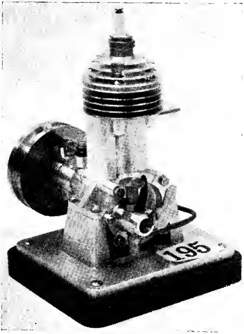
Among models made from "M.E." designs, the most interesting were an example of the "M.E." road roller engine, No. 410, by R. L. A. Bell of Yeovil, and a "Seal" 15-c.c. 4-cylinder engine No. 194 by G. Cheverton of St. Albans. The former engine is a really fine example of workmanship, in which one or two slight modifications have been introduced, not by any means to the detriment of the finished product. There is a notable addition to the engine in the way of a mechanical lubricator, complete with sight-feed glass, which is operated by ratchet gear from an eccentric on the camshaft. The lubricator incorporates a feed and a scavenge pump, the latter having a capacity 50 per cent. greater than the former. Oil is delivered from the feed pump, through the sight-feed into the banjo lubricator of the crankshaft, and the scavenge pump withdraws oil from the base of the crank-

standard type. It is thus possible to control the engine by hand up to the control speed, but the governor takes charge when this speed is exceeded.

It may also be observed that the cooling hopper of the engine has been closed by a cover plate, and a water outlet pipe fitted in the latter, so that it is presumably intended to use the engine in conjunction with a tank or radiator cooling system.

The "Seal" engine calls for little comment, except to say that it follows the design exactly, with the exception of the carburettor, which is of the Kiwi type, and is well made and finished. The exterior finish of this engine has been somewhat enhanced by sand-blasting the castings, but appearance in this respect is slightly marred by the obtrusiveness of some of the joints, possibly through exudation of jointing composition. No information is available as to how this particular

engine works in practice, but it may be of interest to observe that several "Seal" engines are now known to be working quite satisfactorily. A good example of a "Seal" crankshaft is shown by J. C. Hibberd, already mentioned as the constructor of an "Ensign" engine.



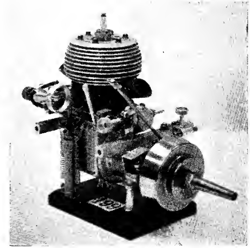
A 6-c.c. "Atom Minor" engine, produced from the solid, by E. D. Clark, of Coleford

There were at least three good examples of i.c. engines built without the use of castings; one of these, No. 201, by H. Scamell of Salisbury, was a very worthy representation of the $2\frac{1}{2}$-c.c. Zephyr engine described in the "M.E." some two years ago. Mr. Scamell, who is a well-known exponent of i.c. engine construction, has modified the design of the engine in some of the minor details, and for the purposes of the exhibition, it was very attractively mounted by a special form of bearer on the rear end-plate.

The 6-c.c. "Atom Minor" Mark III engine, by E. D. Clark of Coleford, No. 195, deserves comment, because this particular engine was originally designed to be built from castings, and one or two rather awkward machining operations have been involved in making the main structural parts from the solid; but this has been very conscientiously carried out, and the constructor is to be commended on the care that has been taken to assure the utmost possible fidelity to design. He has avoided the mistakes made by many constructors, who tend to produce crudity or clumsiness in the main structural components when built in this way.

The third example of an engine built without castings is the 15-c.c. 2-stroke by R. E. Mitchell, No. 199. This engine has been produced specially for model speed boat propulsion, and so far as can be gathered from a superficial examination, it is highly suited for this purpose. The general methods of construction are reminiscent of those which have been used by M. Suzor in some of his very successful engines, though there is no suggestion that the design is, in any way, a copy of his engine. The Suzor type of split casing surrounding the lower part of the cylinder and incorporating the main ports and passages, also the use of multiple ports and twin carburettors, are among the typical features. The crankcase is of square external section, finned to keep the lower part of the engine as cool as possible. A very brave feature is the attempt to synchronise the two carburettor jet settings mechanically, and this is carried out in a way which at least deserves to be fully successful. The delay action mechanism for control of the carburettors is also extremely ingenious. The model may perhaps be rated as the best example of individuality in design in this particular section.

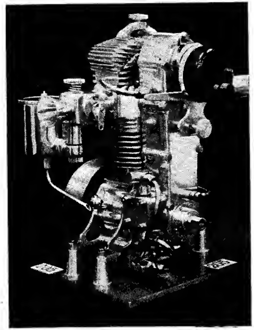
The 30-c.c. overhead camshaft petrol engine by S. B. Woodford, of Lymington, No. 205, exemplifies a form of advanced design which has often been very seriously discussed, and sometimes attempted, in model 4-stroke racing engines, though there are few successful examples of its use. The idea of an overhead camshaft on a single-cylinder engine has long been realised as very desirable, but difficult to carry out really successfully in practice. In this example, the camshaft is apparently chain-driven, the whole of the mechanism being completely enclosed, but the valve rockers are readily accessible by removing two finned covers on the upper casing, which are held in place by a bridge-piece and a single knurled nut. The engine is very completely equipped with a full forced lubrication system and a float feed carburettor with adjustable jet,



A 15-c.c. two-stroke speed-boat engine, by R. E. Mitchell, of Runcorn

and barrel throttle compensation. Very large inlet and exhaust port areas are employed, and if the engine is capable of taking advantage of them it should be highly efficient. I am inclined

to think that the finish of the engine is somewhat overdone, and it has resulted in the contours being blunted by over-energetic polishing of castings. I am also dubious as to the practical merits of the valve rockers, which appear to be



A 30-c.c. overhead-camshaft engine by S. B. Woodford, of Lymington

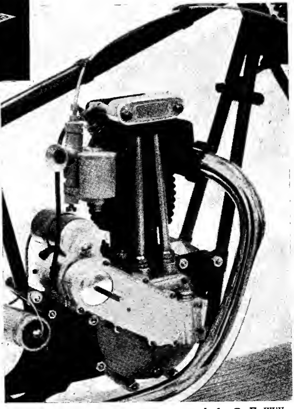
made of aluminium alloy castings with hardened steel working faces, nevertheless the engine represents an interesting, and by no means insignificant effort to attain really high efficiency, and I hope that more will be heard of it in the future.

Although very many constructors of model petrol engines regard the motor-cycle type of engine as the most suitable prototype to follow when high efficiency is required, there are comparatively few who go the whole hog by attempting to make a representative scale working model of this type of engine. This, however, has been done very successfully by G. F. Wills, of London, E.10, who has incorporated it in a 1/4th scale of an A.J.S. motor-cycle. (No. 204.) In some respects it was a great pity that the motor-cycle was exhibited in an unfinished state, as it would undoubtedly have qualified for an extremely high award, had it been complete.

But the engine is complete, and has itself obtained due recognition. It appears to be a faithful representation of the prototype, and is complete with the correct type of slide throttle carburettor, and has a chain-driven dynamo, though the latter appears to be a dummy fitting, in so far as its main function is concerned, the casting, apparently, only containing the ignition contact breaker. I understand that the engine runs quite successfully, and its general workmanship, also that of the parts of the frame which are completed, is beyond reproach.

The 4-cylinder water-cooled petrol engine by W. Savage of Wallington, No. 200, was built some years before the war, and is well known to be quite satisfactory as a working model. I have occasion to know something of this particular engine, having seen it demonstrated on many occasions, and in the course of my experiments with ignition equipment, I persuaded Mr. Savage to equip it with one of my magnetos, which has also been thoroughly successful ever since it was fitted. The engine is of 50-c.c. capacity, 1-in. bore by 1-in. stroke, and the general design is somewhat similar to the design produced by my old friend, Mr. Elmer Wall of Chicago, though many individual features have been introduced by Mr. Savage, and the castings were made from his own patterns.

(To be continued)



The engine of the model A.J.S. motor-cycle by G. F. Wills, of London, E.10

The 1948 Prize Winners

Championship Cups

Locomotives.—H. C. Powell, of Crewe. 1½-in. scale, 7¼-in. gauge L.M.S. 4-6-2 "Duchess of Buccleaugh."

Steamer Cup.—T. Fletcher, of Colne. River pilot boat with twin cylinder internal combustion engine.

Sailing Ships.—W. H. Honey, of Tulse Hill, S.W.2. Norwegian Jagt "Gjoa."

General Section.—J. A. Kay, of Greenford. Triple expansion marine engine.

Club Cup.—Ilford and West Essex Model Railway Club.

The "Wellingham" Cup

R. L. A. Bell, of Yeovil. Horizontal internal combustion engine.

The "Roox Products" Cup

W. H. A. Taylor, of Kingston-on-Thames. Sub-standard cine projector.

Silver Medals

F. Cottam, of Greenford. ¾-in. scale G.W.R. "King" class locomotive.

J. K. Nelson and K. Tyler, of Ilford. Model of typical L.N.W.R. station in an industrial setting.

G. E. Fidler, of North Kensington. Working model of destroyer H.M.S. "Javelin."

W. Browning, of Hendon, N.W.4. True scale replica of sea going tug "Gondia."

Dr. S. Rowland, of Northampton. Model of full-rigged ship "Brynhilda."

W. C. Morrison, of Southall. 10-rater model racing yacht.

L. V. See of Portsmouth. "Atomic III," experimental hydroplane.

H. Fitterer, of Dalston, E.8. Scenic waterline model, H.M.S. "King George V" and H.M.S. "Newcastle."

J. P. M. Horsburgh, of Calver, Derbyshire. Waterline model, Swedish fruit ship "Joh Gorthon."

D. McNarry, of Barton-on-Sea. Waterline model, R.M.S. "Queen Elizabeth."

H. J. Wyatt, of Thorpe, Norwich. Grasshopper pumping engines.

R. R. Watson, of Radlett. A dividing head with direct and differential indexing.

D. L. Butcher, of Kettering. Hand-beaten miniature suit of armour, 15th century.

F. Lewis, of Bromley, Kent. "Raven" 4-berth caravan.

C. B. Reeve, of Hastings. 8-day regulator clock.

Bronze Medals

J. M. Crowther, of Huddersfield. 7¼-in. gauge "Midge" with G.W.R. class cab.

W. D. Hollings, of Bradford. 7¼-in. gauge, 1½-in. scale, 0-6-0T dock shunter.

M. E. Moon of Holloway, N.7. 3½-in. gauge version of Hunslet Quarry Tank Engine.

P. B. Denny, of Acton, W.3. "OO" 18-mm. gauge, "Tingewick" station.

C. T. Standfast, of Ilford. EM (fine) two-rail model of Southern B4 (Adams).

G. C. and F. C. Chapman, of Heathfield. Radio-controlled Algerine class minesweeper.

G. H. Davis, of Brighton. Steam-driven working model of H.M.S. "Vanguard."

N. M. Peters, of Wallington. Working model of H.M.S. "Icarus." (Destroyer.)

R. Roberts, of Chelsea, S.W.3. Working model steamer.

M. M. Melrose, of Hereford. Built-up ship model of "Bounty," 1787.

C. Money, of Sheffield. Perspective model of H.M.S. "Victory."

E. N. Taylor, of Gosport. Waterline model of S.V. "Archibald Russell."

Capt. J. Shenton, R.N., of Bodmin. Sailing ship in glass case.

H. Brownless, of Doncaster. Brooke motor cruiser.

D. C. Wray, of Edgware. Yorkshire fishing coble "Eliza."

G. A. White, of London, N.W.11. Working representative model of Barking smack (1830).

D. S. Anthes, of Sheffield. Waterline model of s.s. "Silvia Onorato" ashore on the Goodwins.

K. P. Lewis, of Birkenhead. Passenger and cargo liner, "Robert L. Holt."

M. C. Makertich, of Wimbledon. Scale model of "Cutty Sark."

E. B. Wilcox, of Weaverham. Model compound surface-condensing marine engine.

A. F. Winter, of Portslade-by-Sea. Generating set—steam engine, dynamo and switchboard.

A. Dunn, of Glasgow. Compound condensing marine engine.

G. F. Wills, of Leyton, E.10. ¼-scale motor-cycle (unfinished) with engine completed.

S. V. Woodford, of Lymington. 30-c.c. o.h.c. petrol engine.

R. L. A. Bell, of Yeovil. Horizontal i.c. engine.

F. H. Buckley, of Ashford, Middlesex. One-sixth scale model of "P" type 8 h.p. M.G. car chassis.

F. H. Tapper, of Harborne, A. J. Kent, of Smethwick and F. Moulson, of Birchfields. Pair of 1-in. scale models of Ransome Sims & Jeffries 6 h.p. steam traction engines.

W. Browning, of Hendon, N.W.4. 1899 model New Orleans car.

F. G. Boler, of Leatherhead. Model racing car (self-propelled).

C. F. Toms, of Bristol, 6. Jeweller's lathe.

J. Waddington, of Halifax. Equipment for "Mercer" dial gauge in oak case.

G. Clasby, of Brighton. 1/72-scale model of "Anne of Cleves House," Ditchling, Sussex.

G. H. Landymore, of Bury St. Edmunds. Model of Ixworth Church.

J. McCreesh, of Buckhurst Hill. Commercial refrigerated cold room.

R. Edgar, of Peckham, S.E.15. Ship model, "Golden Hind."

Diplomas

Very Highly Commended.—49 awards.
Highly Commended.—37 awards.
Commended.—26 awards.

Operating Repeater Motors

by H. Perraton

I have had so many enquiries concerning a piece of ex-R.A.F. equipment, known as a repeater motor, that it seems worth while to describe a method of obtaining a suitable three-phase a.c. current to operate them for driving small models and similar uses.

These repeater motors are employed in the air position indicator for the remote control of an electrically-operated contact switch; such a device is not a true motor in the sense of continuous operation, but it can, without any alteration, be used as a low-voltage squirrel-cage induction motor.

My first experiments in this direction led me to try to obtain a suitable 3-phase a.c. supply from the 50 cy. mains. Although not generally known, a 2- or 3-phase current can be obtained from the single-phase supply mains by the employment of suitable condensers and inductances. The correct phasing of the currents can be calculated from the usual data in any textbook on a.c. practice.

If a 3-phase supply is desired, the currents should be 120 electrical degrees apart. A transformer should be employed, giving a 25-28 volt output, which is then split up as shown in Fig. 1.

The current through C will be the leading phase, that through R the intermediate, and I the lagging phases respectively.

Now, if it is not desired to bring out the "star point" of the windings on these motors, that is the point of common connection of the inner coil ends (a somewhat tricky operation, which necessitates the removal of some of the windings, the re-assembly of which may be beyond the powers of the unskilled), recourse must be made to the expedient of using two phases only.

I found that the 3-phase experiment was not altogether successful owing to this last mentioned difficulty, so I devised the 2-phase circuit, shown in Fig. 2.

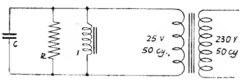


Fig. 1

The value of the condenser C should be in the region of 80-120 mfd.; this, at 50 cy. would give a reactance of 15-16 ohms, which at a pressure of 25 volts, would give a current of 1.6 amps. approximately. The resistance R should have the same value in order to balance up the circuit. Should the values of condenser and resistance be required to be varied, the condenser reactance can easily be calculated from the formula $\frac{1}{2\pi FC}$ which in the case of capacities measured in microfarads becomes $\frac{10^6}{2\pi FC}$ where F = frequency, C = capacity in microfarads.

The third terminal is taken straight to the other output terminal of the transformer. Under this arrangement, the motor will function as a 2-phase squirrel cage, and will be self-starting.

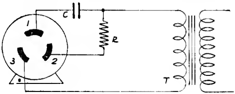


Fig. 2

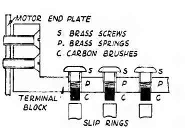


Fig. 4

Should it be desired to use the motor as a 3-phase, and hence obtain the maximum results from it, and perfectly balanced output of this character can be obtained from a 24-volt d.c. shunt wound motor.

This motor should be selected, having a nice bit of space on the shaft in front of the comm. end. There are many of these ex-R.A.F. and Army patterns on the market, beautiful little machines of about $\frac{1}{4}$ h.p., quite suitable for the above purpose.

Having found a suitable machine, strip it completely. On the motor shaft in front of the comm. are mounted three tight-fitting bushes, made from some suitable insulating, such as "Tufnol," "Bakelite," or any other substantial material. These bushes can be quite close together with only about $\frac{1}{16}$ in. between them; they must, however, be a tight press fit on the shaft. On each of these bushes must be fitted a copper or brass ring or band. These can be made a tight press fit, as before, and should be about $\frac{1}{16}$ in. thick. These same rings could be secured by small countersunk screws. The whole assembly should not be trued up in the

lathe, and the surface of the copper slip-rings polished.

Having done all this, it remains only to make the necessary connections to the comm. Select 3 comm. segments, 120 deg. apart, if the comm. has 36 segments, then use every 12th segment. To the front end of each segment, drill a small hole of not more than about 3/32 in., and insert a short length of copper wire of 13 or 14 s.w.g. These same wires should be firmly soldered in, making good electrical connections. The other ends of these wires are soldered to the copper slip-rings, one to each ring. One may wonder as to how to connect the two outer rings without overlapping the first, but if three holes are made through the insulated bushes in the position of the three wires, these wires then covered with sleeving, which can be obtained from any radio dealer, both pushed through its respective hole, then soldered to its copper ring on the outside edge. (Fig. 3.)

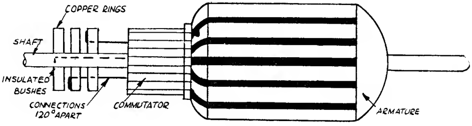


Fig. 3

We shall now require a set of brushes to collect the current from the slip-rings. To do this, make a terminal block from some insulating material as before, in the shape of a letter L, as per diagram, the base of which is formed by the L portion. This can be bolted to the end-plate of the motor. In the straight portion of this block, drill three holes to correspond with the three slip-rings on the motor shaft. These holes should be just large enough to allow the carbon brushes which they carry to move up and down freely, but with little or no sideplay. The terminal block should be fixed so as to allow not more than about 3/32 in. between it and the slip-rings. The carbon brushes should now be inserted, and fitted with a small brass spring at the rear in each case to keep them in contact with the slip-rings. These brushes and springs can be retained by brass screws, screwed into the block at their rear. (Fig. 4.)

This alteration having been carried out, and the motor reassembled, make sure that everything is moving freely, and that all three brushes are making good sliding contact on the three slip-rings.

A diagram of the complete machine and connections is shown in Fig. 5.

The 3-phase output is obtained from the three brass screws on the terminal blocks, the three terminals on the repeater motor should be linked up with these. It simply remains now to connect up your motor-generator with your

(Continued on page 275)

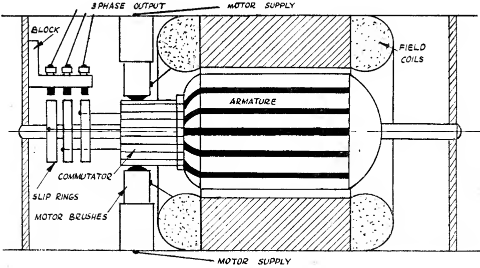


Fig. 5

A $3\frac{1}{2}$-in. Gauge L.M.S. Class 5 Loco.

by "L.B.S.C."

THE valve-gear on the full-sized L.M.S. Class 5 engines is a pretty good example of a modern arrangement combining lightness, strength, accessibility, and good steam distribution; and the arrangement you see in the reproduced illustrations, follows full-size practice as far as consistent with working conditions on $3\frac{1}{2}$-in. gauge. Nobody would mistake the "new look" combination-lever, the slender expansion-link, or the slotted girder which carries it; and I might mention that the girder gave me the biggest headache of the whole doings. On big sister, the gear frame and its forward extension are castings. To reproduce them in $3\frac{1}{2}$-in. gauge size would give our advertisers' pattern-makers and foundrymen another headache; so I wangled out a wheeze whereby the whole bag of tricks can be built up, yet the personal appearance of the completed job "complies with the regulations" in a manner of speaking. Just as some folks raise an awful moan about using slotted screws in small locomotive work, whilst all the time they are freely used in full size, so others shed tears about using offset rods in a valve-gear; yet on the full-sized Class 5's, both the combination-lever and eccentric-rod are bent inwards from the drive end, to connect with the valve fork and the tail of the expansion-link respectively. Well, on the little one, I have considerably reduced the offset on the combination-lever, and done away with it entirely on the eccentric-rod, substituting a straight rod; as I guess somebody or other will be writing in to tell me *that* isn't right—*what* a life! Finally, the lengths of the various rods between pin centres are nearly all in strict proportion to those on the big engines, the only differences being those necessitated by my own idea of ports, valves, and setting; so young "Doris" should be able to perform in the manner usually observed among her full-sized relations. Now let's get on with the job.

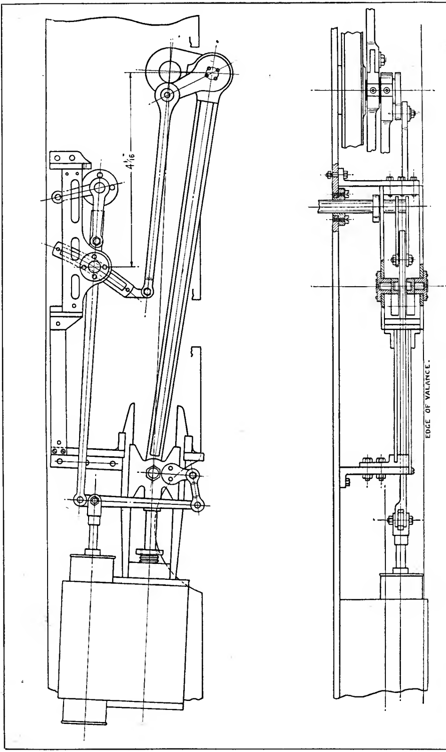
Lap-and-lead Movement

The first thing you will notice about the combination-lever, is that it hasn't any forks at all, but is simply a plain bar with a small offset in it. Owing to its length, it is possible to separate the pins at the top, to a spacing sufficient to allow two ordinary forks to be used, one above the other. This cuts out right away, the usual extra-wide valve-fork or crosshead, and a forked combination-lever to take the radius rod. No detailed instructions are needed; simply file or mill it from a piece of ordinary $\frac{1}{8}$-in. by $\frac{1}{4}$-in. mild-steel, and case-harden all the holes. Alternatively, use "gauge" steel (ground flat stock) and after bending to shape, harden it, and then draw the hardness out of the centre part by applying a red-hot piece of iron bar, or something else with plenty of "therms" in it, to the middle part of the lever. Clean well, and polish up with fine emery cloth or other abrasive. Beginners especially, remember that as the holes in all valve-gear parts should go squarely through the rods and links, all holes must be drilled either on a drilling machine, or in the lathe; and it is advisable to ream them that way too, to ensure perfect fits and sweet working. I use a little round cast-iron block, truly faced on both sides, with a lot of varying-sized holes in it. It was originally part of the boss of a chuck-plate casting which was too long. The work is placed on this block, over a hole of appropriate size to receive the drill or reamer, and a dead square (Pat again!) hole is the result, although, begob, it's round!

Union Links

These items are made from $\frac{1}{4}$-in. square mild-steel. If you get a bit long enough to grip under your slide-rest tool-holder, you can run it up to a $\frac{1}{8}$-in. slotting cutter on a spindle in the chuck, and then reverse it end-for-end to cut another slot. Then saw the bits off to a bare 1 in. length, and slot the sawn ends by running them up to the same cutter, as the crosshead arms are same thickness as the combination-levers. When I had no milling machine, and did my slotting as above, I held short bits like these, in a sort of tool-holder; this was merely a bit of square mild-steel bar, with a *round* hole drilled down the end, the diameter of the hole being equal to the size of the square across the corners. A set-screw held the short bit in the holder. They say a square peg doesn't fit a round hole; well, just recently I made a fly-cutter spindle for my milling machine, simply drilled a round cross-hole through it, and fitted a set-screw. Up to the present, all I've used in that round hole are square tools, and nary one has slipped yet, although the intermittent clouting they get when in use (one whack per revolution!) would shift anything the least bit shiftable. Round off the ends of the union links by aid of a Wilmot filing jig or button—described umpteen times—and recess the middle for the sake of appearance. Note: as the union-link misses the guide-bar bracket by a small fraction of an inch, twice per stroke, the fixing bolt attaching same to the crosshead arm mustn't project on the inside; so countersink that side of the union-link fork, as shown in the section, and turn up a little bolt for each link, from a bit of $\frac{3}{16}$-in. round mild-steel, as shown in the detail sketch.

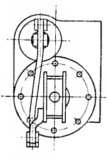
The valve forks or crossheads are made from $\frac{5}{16}$-in. square mild-steel. Take a piece, as before, long enough to hold in your slide-rest; cross-drill the end, using No. 32 drill, then slot as above. Saw off the piece to about $\frac{3}{4}$ in. length, and ditto repeato. Chuck each in four-jaw, plain end outwards, set to run truly, and face to length, $\frac{1}{2}$ in. from centre of cross-hole.



Valve-gear for "Doris"

Turn down $\frac{3}{16}$ in. of the end to $\frac{1}{4}$ in. bare; for the sake of appearance. Centre, drill No. 22 or 5/32 in., and tap $\frac{3}{16}$ in. by 40. Round off the other end, then reduce the thickness across the jaws to 9/32 in., so as to give the fork of the radius-rod plenty of room to operate. Poke a $\frac{1}{8}$-in. parallel reamer through the holes, and make a little bolt to fit, from a piece of $\frac{1}{8}$-in. silver-steel shouldered down each end to 3/32 in., screwed 3/32 in. or 7-B.A., and furnished with commercial nuts.

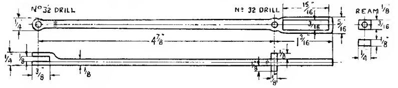
No need to assemble the lap-and-lead movement yet; we will do the whole bag of tricks at one fell swoop later on.



Clearances in lap-and-lead movement

Radius-rods

There are two ways of making the radius-rods. If you have a milling machine, make them from $\frac{5}{16}$ in. square mild-steel. When milling a long thin rod, I usually solder it to a bit of much stouter bar, say about $\frac{1}{2}$-in. square in the present instance, and grip that in the machine-vice. You can then mill down to 1/32 in. thickness, if a job calls for it, without fear of buckling or bending; it was the only way I could mill the long spidery brake-rods for "Grosvenor's" clasp brakes on her big driving wheels. If no milling machine is available, use $\frac{1}{8}$-in. by $\frac{5}{16}$-in. flat mild-steel for the main part of the rod, and braze a little block on the end from which to form the fork or clevis. You should know how to do the latter job by now! At $4\frac{7}{8}$ in. from the centre of the hole in the fork, drill a No. 32 hole; and if ever one hole in the valve-gear needed more than another, to go through dead square with the rod, this is the boy. The reason is, that it carries the pin on which the two curved die blocks are mounted; and if those merchants aren't exactly dead in line, they are going to bind in the link slots, and cause undue wear in all the pin joints in the gear. The pin itself is nothing startling, being merely a $\frac{3}{8}$-in. length of $\frac{1}{8}$-in. round silver-steel squeezed in when erecting the gear; but it's just one of the little things that matter, like the odd inch of wire in the fuse box, that chooses the exact minute when you are halfway through a cylinder bore, to stop the lathe and put your workshop lights out. The slot at the end can be drilled and hand-filed in less time than it would take to set up and machine; drill a few 3/32-in. or No. 20 holes down the middle, join them with a rat-tail file, and finish with a warding file until you can run a bit of $\frac{3}{16}$-in. square steel from end to end, easily, but without shake. The straight die-block is just a $\frac{1}{4}$-in. length of $\frac{1}{8}$-in. by $\frac{3}{16}$-in. silver-steel, with a $\frac{1}{8}$-in. reamed hole in the middle, and is fitted when the gear is erected.



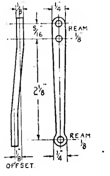
Radius-rod

Expansion-links

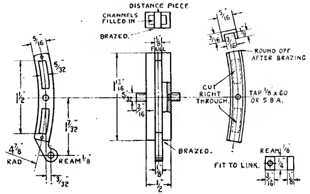
Two pieces of curved channel steel, $1\frac{7}{8}$ in. long, and of a section as shown in the illustrations, are needed for each expansion link. These will probably be available from two or three of our advertisers; but they can be made by exactly the same processes as described a few weeks ago for the Joy curved guides for "Maid of Kent" and "Minx." Owing to the length of the radius-rod, they would need a 10-in. faceplate at least, for forming with a parting tool; but could easily be done by aid of the simple rig-up I described for use on the average small home-workshop lathe. Incidentally, this type of expansion-link has far greater wear-resisting properties than the kind using a single central link and forked radius-rod. Anyway, whether you make the bits of channel, or buy them, cut them to the given length; and then, exactly in the middle of each, drill a No. 41 hole. Put them together channel to channel, with a bit of $\frac{1}{8}$-in. steel as a distance-piece at each end; at the top, it should go down between the links to a depth of 5/32 in. The bottom bit should be big enough to form the link tail after brazing. Now put a bolt through the middle holes, to hold the bits together; and to make a posh job, fill in the channel each side of the distance-pieces, with a little bit of steel filed to suit. See top view of assembled link. Drill a No. 52 hole each end, clean through links, channel blocks, and distance-piece; drive in a bit of 16-gauge spoke-wire, or $\frac{1}{16}$-in. silver-steel, and rivet over the ends. Don't bother to form proper heads, they are filed off afterwards. Now braze each end solid; just apply a dab of wet flux (Boron compo or anything similar) to the outside—*not* between the links on any account—heat to bright red, touch with a bit of brass wire, let cool to black, quench in water, and clean up.

Take the bolt out of the middle, put a No. 40 drill through, and tap both sides either $\frac{1}{8}$ in. by

60, if you have the necessary tackle, or 5-B.A. Drill a couple of holes through with No. 30 drill, above and below the tapped holes, and with round and flat files form two slots, as shown by the dotted lines. Be careful not to file these wide enough to come level with the inside of the channel, or the die-blocks will come out. Trim off the top of the link, then mark out, drill and ream the tail, and file it to outline, as shown. It is much easier to form the tail *after* the two halves have been brazed together; if the tail is filed to shape and drilled *before* fitting to the link, the chances are a million dollars to a pinch or slightly round it if you like; then screw both trunnions tightly into each side of the link. Come loose? Not on your life—how can they get out when the bushes in which they work are drilled " blind "? Take a look at the plan view of the assembled gear. Also, when I say screw them in tightly, I mean just that. They should go in about one thread with finger pressure; then put a bit of copper sheet over each jaw of your bench vice, grip the trunnion in it, and turn the link. That should screw them home tightly enough to " stay put " for the lifetime of the engine. If you're still dubious,



Combination lever



Expansion link

of snuff that it will shift during the riveting and brazing processes, and then, as our R.A.F. friends would say, you've had it, chum!

The trunnions are two $\frac{1}{4}$-in. lengths of 5/32-in. round silver-steel, with $\frac{1}{16}$ in. of the end reduced to $\frac{1}{8}$ in. and screwed to fit the tapped holes in the sides of the links. Don't forget the wheeze of making them from a longer bit of steel, turning down $\frac{1}{8}$ in. or more and screwing it, so as to get a full thread, then facing off until the screwed part is $\frac{1}{16}$ in. long only, and the thread jolly tight in the hole. Reverse in chuck, and face the other end until the plain part is a bare $\frac{3}{16}$ in. long. Chamfer off the sharp edge, give them a dose of " Easyflo "; you can do that without melting the brazing. Let it form a weeny fillet between trunnion and link, and countersink the bearing bushes to clear, when making the latter. There is nothing special to note about the die-blocks, as the dimensions are given in the illustration, but they should be fitted to the links before the latter are brazed up, I don't mean left in whilst brazing; just see they slide properly without being slack, then take them out again. They should be case-hardened, if mild-steel; if " gauge " steel (ground flat stock) is used, they can be hardened right out, and will last the lifetime of the engine.

Operating Repeater Motors

(*Continued from page 271*)

24-volt supply in the orthodox way. You will find your little 3-phase repeater motor running quite well, and in step with the motor generator or alternator.

Should the power of the repeater motor not be all that is desired, try putting a load on the motor alternator shaft to slow it up a bit, this will reduce the frequency, and in case the windings of the repeater motor have too many turns, and thus too much reactance, you will find that the speed of the repeater motor will be also reduced, but the power output may be much improved.

An improvement on the above method would be to insert a variable resistance into the field circuit of the motor-alternator, when the same result would be obtained much more conveniently.

Readers will find this an extremely interesting little experiment which is well worth trying, and which can increase one's knowledge of 3-phase electricity considerably.

*A 1.5 c.c. Compression-ignition Engine

by "Battiwallah"

PLACE the die on the bed with the header vertical, and immediately afterwards remove the metal pot from the fire and pour fairly quickly, completely filling the header. If you have not poured molten aluminium before you will find it somewhat awkward stuff, for it seems rather reluctant to commence pouring. If then you have a piece of iron wire handy, just help the metal to start when the pot is tilted for the pour. When you have tried this job you will appreciate the need for headers of good size.

Don't be in a hurry to see the results of your efforts; allow the die and cast to cool naturally before attempting to remove the latter.

When removing the end-plate casting from the die, first take off the header by removing the U-piece. Then saw off the aluminium right up against the die, removing with a file any aluminium remaining outside. Resting the edges of the largest end of the die on the vice-jaws, with the lug-end of the casting facing upwards, tap the casting out of this part of the die; it should come fairly easy if brought through squarely. Then the split part of the die will easily separate from the casting, when you should have a good clean casting. If the metal has not filled the die, then the trouble is insufficient heat.

When removing the crankcase casting from its die, the procedure as regards the header is just the same. On removing the bolts and set-screws holding the die parts together, the bottom parts will come away quite easily. The top piece *D* will need a little persuasion; by gently tapping the casting squarely it should clear easily. If any spew has occurred between the top plate *E* and the part *D*, just file it off before attempting to remove the latter. The top two *A* parts may need tapping off as there may be a small pinch between the cylinder-fixing lugs and the engine holding-down lugs. As the part *C* has been tapered, there should be no trouble in tapping the casting clear; and once again you should have a nice clean casting.

It is not a bad plan to make two of each casting whilst all the paraphernalia are handy, in case a casting has been spoilt in the machining processes.

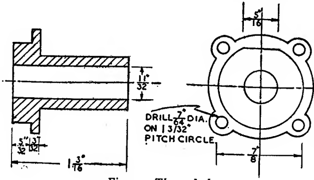


Fig. 7. The end-plate

Machining the End-plate

Our extravagance in metal for the castings will, no doubt, horrify the production man, for we have to machine most of it away. But our concern was simplicity in making the dies; so we have a good excuse and, after all, it will not take long to machine either casting, because we have had an eye on this task in designing them.

Let us proceed with the end-plate casting first, as in Fig. 7. It has been made with ample length and it can be firmly gripped in the self-centring chuck to run truly, leaving sufficient length free for finally parting off. With a knife-tool and taking gentle cuts, face off the end flange to 1/4 in. thick; there is no need to face the return of the flange, for the casting should have a smooth and neat appearance, assuming that the die was nicely finished inside. Then turn down the flange to 7/8 in. diameter for 5/32 in. Centre the end with a Slocombe, put through a pilot drill, and finish with an 11/32-in. drill. If uncertainty exists as to the likelihood of finishing truly with a drill, it is better to finish with a small boring tool. Drill the four 7/64-in. diameter holes. To make the most of the available metal, they should lie on a pitch circle 1/32 in. larger in diameter than the outside diameter of the flange. Finally, file the flat 1/16 in. wide; this is to facilitate the gas passage on transfer. Then part off to length.

Machining the Crankcase

The crankcase casting claims our attention next. Very carefully centred, drill a 3/32-in. hole about 3/16 in. deep in the projection at the bottom of the casting. The slightly tapered projection left on the casting provides means of gripping the latter firmly in the chuck. If the taper is but very slight, a firm grip may be possible right away; otherwise just file three small flats equally to coincide with the chuck jaws to obtain parallel surfaces for gripping; two or three strokes of a file will do the trick and the casting should run sufficiently true for

*Continued from page 256, "M.E.," September 2, 1948.

our needs. This can be checked by presenting to the outer periphery of the crank chamber a tool mounted in the slide-rest. Now we know from the die dimensions that the distance from the face of the crank chamber to the vertical centre line of the casting is ½ in.—remember we said that shrinkage was negligible—hence 3/32 in. has to be removed from this face (see Fig. 8), but don't do so just yet. Turn out the crank-case to a depth of 9/16 in. + 3/32 in., and at ⅞ in. diameter so that the end-plate casting neatly fits. It is as well to turn a groove ¼ in. wide and 1/32 in. deep symmetrically about the centre-line to give additional clearance for the big end of the connecting-rod. Now face off to 13/32 in. from the vertical centre-line. This dimension can be readily checked from the centre of the hole in the projection in the bottom of the casting; just lay a straight-edge against the turned face and measure its distance to this centre. This should leave the crank chamber $\frac{9}{16}$ in. deep. In the facing operation the cut will have to be continued to the top of the casting to remove the surplus metal from the projection in which the transfer port is cut. This will also trim off the holding-down lugs.

Now grip the casting with the drill jaws of the chuck inside the crank chamber. If the chuck is too large then the work must be held in a four-jaw chuck, but a packing-piece must be inserted in the bore, or it may come to grief. By the first means of gripping, the job is readily centred; the back end can then be turned up in accordance with the drawing. Keep to the given dimensions here, or you may have a break-through. The 13/32 in. dimension from the centre-line can be checked as before, and the finished width of the crank chamber should be $\frac{13}{16}$ in.

Gripping the piece by the bottom ⅜ in. diameter boss in the self-centring chuck, with the top end of the casting running truly, centre with a Slocombe. The truth of the top end of the casting can be checked with a tool in the slide-rest as a gauge.

Put the faceplate with an angle-plate loosely mounted thereon on the lathe mandrel, and place the casting between centres. If the angle-plate is carefully brought up to the work and the latter clamped to the angle-plate, the casting is readily centred for boring the cylinder-liner jacket. The casting should be clamped with the end-plate face against the angle-plate to ensure that the two bores will be at right-angles to each other. It is also advisable to measure the distance from the top of the casting to the top side of the crank chamber bore so that the depth of boring the liner jacket can be known in order to avoid a risk of a break-through to the recess which has been turned at the back of the crank chamber. Being satisfied that the work runs truly, proceed to bore. Now this bore is very important, for it must be smooth and parallel because the cylinder liner must fit so that no gas leaks can occur. If you are not quite confident as to the ability of your lathe to finish the job properly, it will be better to finish the bore by lapping. If this course is decided upon, finish as closely as the lathe will permit, leaving just a few "thous." for lapping. More will be said about lapping later on.

Face off the top so that the distance to the horizontal centre-line of the casting is $1\frac{5}{16}$ in. The best way to check this is to face to $1\frac{3}{4}$ in. to the bottom of the crank chamber as measured by a depth gauge, after deducting the depth of the clearance groove for the connecting-rod.

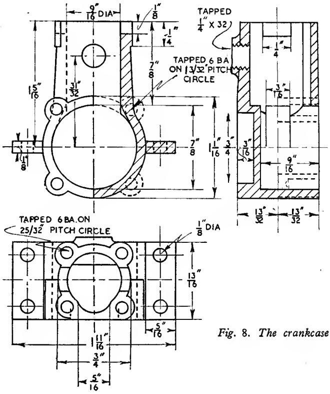


Fig. 8. The crankcase

A small amount of metal will have been left at the bottom of the vertical bore because of the curvature of the crank chamber; this can be filed off, and, at the same time, the two $\frac{3}{16}$ in. wide flats for the connecting-rod clearance can be filed. The transfer passage can also be filed unless it is decided to mill it. If it is filed there is no reason why it should not be given a rectangular section. If it is milled, mount the work

on an angle-plate fixed to the vertical slide and use a ⅜-in. end-mill.

File out the exhaust ports, drill the holes in the holding-down lugs, and drill and tap the carburettor boss ¼ in. by 32 t.p.i. The template shown in Fig. 6 is needed to mark off the tapping holes at the top of the casting; it is positioned by a 9/16-in. round stub inserted in the bores of the casting and the template. Again, do not forget to mark which side of the template faces the work so that it can be placed the right way

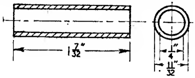


Fig. 9. Main bearing bush

round when it is used to mark off the drillings for the cooling-fins. Drill No. 44 or 3/32 in., and tap 6-B.A. The drillings for the front end-plate are marked off from this part with the flat at the top; they also are drilled No. 44 or 3/32 in., and tapped 6-B.A. Finally, saw off the ⅜-in. boss at the bottom of the casting and smooth off with a file and there you have another part finished, except that a little lapping may be required in the cylinder-liner bore.

The Main Bearing

There is a choice of materials for this part, either phosphor-bronze or case-hardened steel. If the latter is decided upon, use a part of the shank of a ⅜-in. machined bolt—the unscrewed part—as these bolts are of good-quality steel as a rule; otherwise use a piece of good quality mild-steel rod. Silver-steel which will, of course, harden right through can be used, but there is always the chance of distortion in the hardening process which is troublesome to deal with.

agent, which will cause a substantial coating to adhere in the bore. Now bring the work to a very bright red heat and plunge it quickly and vertically into cold water and the hardening is done. Clean off the remaining deposits and the part is ready for the last operation, which is lapping.

If you are familiar with this process, make the ¼-in. diameter lap and go ahead, whether the part be steel or phosphor-bronze; for, in either case, a lapped finish is highly desirable. If, on the other hand, lapping is a bit of a mystery, just put the part on one side until the mystery is elucidated, which we will do later on when we come to the cylinder.

The Crankshaft

This little part has to withstand some pretty severe stresses and we can, therefore, afford to take no risks with a built-up article. It must be made from a solid piece of good-quality steel, and here again a machined bolt fills the bill nicely, especially if it is one of the high-tensile kind used for automobile purposes. One of 9/16 in. diameter and 2½ in. long is needed. Failing this a 3-in. long piece of good mild-steel should be used, 1 in. in diameter.

The details are shown in Fig. 10. From time to time, a good deal has been written in this journal on setting-up and machining small crankshafts so that it hardly seems necessary to deal at great length with the machining of this part. Let us then just go over the principal points.

Assuming the piece of 1-in. diameter bar is used, face each end and accurately mark the centre of the piece at each end, using V-block on a plane surface and scribing with a surface gauge. Punch the centres. Clamp the piece in the V-block and set the surface gauge scriber exactly to a centre and check that the other one is the same. Put a couple of 9/32 in. diameter pieces of material under the V-block and scribe

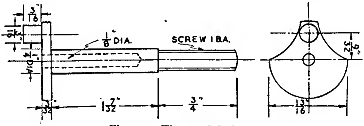


Fig. 10. The crankshaft

The bearing is a simple plain bush as shown in Fig. 9. Finish the outside two thous. larger than the bore in the end-plate as the bearing bush has to be a drive-fit therein. Ream the bore of the bush, or finish it with a small boring-tool, taking a very fine cut, but the lathe must be capable of giving a truly parallel finish if boring is resorted to.

If the bush has been made of mild steel, case-hardening is the next task. Heat to a bright red and immerse the part in "Kasenit" or potassium ferro-cyanide; the latter is obtainable from the local chemist usually. Allow the work to cool to black while still immersed in the hardening

a horizontal line each end. Then turn the work so that these lines become vertical as checked with the try-square, and scribe again with the surface gauge, but without the 9/32-in. pieces under the V-block, and there you have the crank-pin centres marked on each end. If a bolt is to be used for making the crank-shaft, firmly lock a couple of nuts on the screwed end and, having filed the nut and bolt-head faces so that the markings can be seen, proceed just as has been described for the 1-in. bar. The obvious advantage of the bolt is that much less metal has to be machined away.

(To be continued)

A FINE SIGHT!

by W. J. Hughes

Photos by Peter E. Hind, Press Photo Agency

IT is told that when the raw recruit was asked at musketry practice to define "a fine sight," he answered "six dinners on one plate." But had he been a model engineer, he might have replied "Four traction-engines all in a row"—which was the "fine sight," very unusual offside. Unfortunately, owing to lack of time, it was not possible to measure up this engine completely, but the drawing gives the principal dimensions of the other two engines. I feel sure that these, with the photographs, will be of great help to anyone wishing to build a model.

Photo No. 1—Traction engine No. 1275 built by Messrs. William Allchin, Globe Works, Northampton. This is he last photograph which will ever be taken of this old-timer

for 1948, which met my eyes recently in a yard at Gleadless, Sheffield.

These engines belong to two brothers who are agricultural contractors, and whose lament it is that, owing to the fuel problem, it is easier to run a Fordson than a steamer today. Thus they have several Fordsons in constant use, while the four traction engines stand idle, though in good running order.

Three of the latter were built by William Allchin, Ltd., Globe Works, Northampton, and are numbered 1275, 1407 and 3251, respectively. No. 1275 was built just before the turn of the century, No. 1407 in 1912, and No. 3251 in 1925. The first two are identical in most respects, but No. 3251, called *Royal Chester*, differs in several particulars—notably in that both axles are sprung (the other engines being unsprung), while the boiler is $2\frac{1}{2}$ in. less in diameter, and the smokebox is 4 in. longer. In addition, the driving position is at the near side on *Royal Chester* instead of the

"Discretion is the Better Part . . ."

In talking to Jack, an employee who had driven these engines hundreds of miles —perhaps thousands—I heard many amusing and interesting anecdotes of which the following is typical, though unfortunately it is not possible to define in print the delightfully droll and telling inflexions of the voice.

"Ah wor gooin' dahn a country lane," said Jack, "wi' a set o' threshing tackle on t' back, when up comes a car t'ords me wi' a bloke in it as thowt he wor sumb'dy. Ah pulled up, an' he pulled up—couldn't do nowt else, 'cos t' lane wor too narrer to pass.

"Well, o' coorse, Ah couldn't go back wi't' train on, an' any road Ah knew if he went back a bit ther' were a place to pass.

"Howivvér, he said he worn't gooin' back, an' Ah said Ah couldn't, so after some argy-bargy Ah climbed back in t' cab an' put mi hand on t' throttle lever. 'Good,' says t' car-owner,

pleeased-like, 'you're going back, are you?' in a posh voice, o'coorse. 'Nay,' Ah says, 'Ah'm comin forrard in 'aif-a-minnit, an' tha can pleease thisen.'"

"And what happened?" I asked. "Oh" said Jack laconically "he went back awreight."

for the benefit of those who are not so expert.

On referring to photograph No. 3, it will be seen that the crankshaft carries two gears, which have a flat pulley between them. Over this pulley passes the belt which drives the governor, when the latter is in use, as in threshing corn.

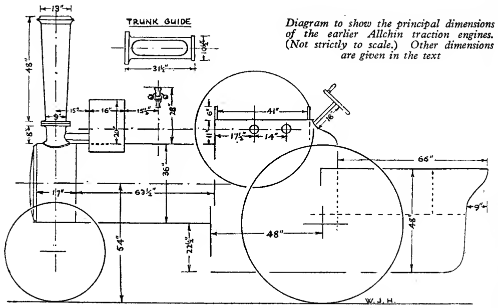


Diagram to show the principal dimensions of the earlier Allchin traction engines. (Not strictly to scale.) Other dimensions are given in the text

Differences in the Engines

Photo No. 1 shows a general view of engine No. 1275, with part of *Royal Chester's* chimney showing beyond. All the other photos are of No. 1407, and one or two of the slight points of difference may be noted by comparing them. For example, the former has a "spud-pan" on the front axle, while on the latter, the steering-chains are attached to clips fastened round the front axle near the wheels. (See photo No. 2.)

On photo No. 4, three different features are apparent—first, the comparatively large lubricator mounted on the valve-chest; secondly, the pipe and stop-valve leading backwards from the top of the valve-chest. This is not a standard fitting, but was added by a former owner to obtain really dry steam for the injector in the cab. Thirdly, a steam-pipe and stop-valve lead from the bottom of the valve-chest forward to the blower.

Again, No. 1275 has no flywheel brake, while on photo No. 3 may be seen that fitted to No. 1407. It consists of a hardwood block sliding in a square-section tubular guide behind the flywheel. On turning the small handwheel, which can just be seen, a screw forces the end-grain of the block on to the flywheel rim.

Changing Gear

I hope road-locomotive experts will forgive me if I give a brief explanation of the gearing, The second shaft also carries two gears, back to back, so to speak, and these slide (both together, of course) on four long keys machined on this shaft. Hence, if this "double" gear be slid towards the flywheel, to mesh with the smaller of the other pair of gears, the engine will be in low gear; but if it slides to mesh with the larger of the crankshaft gears, the engine will be in high gear. As shown in the photograph, the engine is in the "free-running" position, i.e., the crankshaft is not coupled to the layshaft at all. The layshaft drives the hind axle through spur-gears distinguishable at the left-hand side of this photograph.

The layshaft gears are moved sideways by a fork which can be seen on the end of a short transverse shaft which bears in a bracket bolted to the back-plate: the transverse shaft is moved by the slightly cranked lever pivoted on the same bracket.

Other Useful Information

Further particulars of No. 1275 and No. 1407 are given below, with particulars of No. 3251 in parentheses (where obtained).

Rear Wheels: 6 ft. diameter, 16 in. wide on tread, 16 spokes, one driving-pin. (No. 3251: 6 ft. diameter, 18½ in. wide, two driving-pins.)

Front Wheels: 3 ft. 10 in. diameter, 9 in. wide on tread, 12 spokes. (No. 3251: 3 ft. 10 in., 9 in., 10 spokes.)

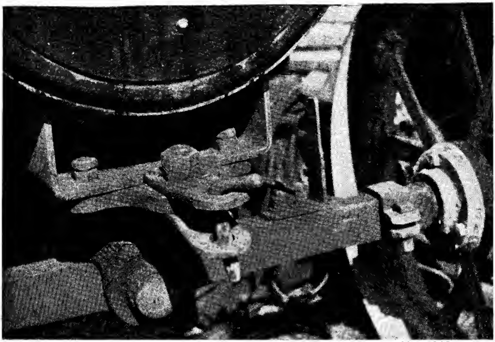


Photo No. 2—Front axle mounting of No. 1407. Note difference between this and No. 1275

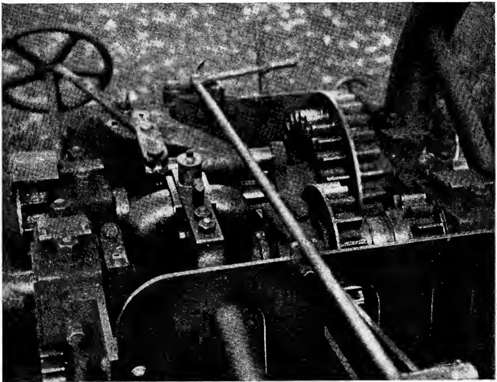


Photo No. 3—Part of " the works." Note pin and hole method of locking gear-change lever in position

Flywheel: 4 ft. 6 in. diameter, rim 6 in. wide by $1\frac{3}{4}$ in. thick, 6 spokes. (No. 3251: ditto.)
Single Cylinder: 10 in. bore by 12 in. stroke.
Connecting-rod centres: 3 ft. 3 in.
Eccentric-rod centres: 2 ft. $8\frac{1}{2}$ in.
Eccentric-sheave diameter: 7 in.
Crankshaft as forged: 4 in. diameter. (All journals turned to $3\frac{1}{2}$ in. diameter.)

The Fourth Engine

After all these details of the Allchins, you will be wondering what about the fourth engine in the row?

Well, this one is a Marshall, but that is all I am going to say about it at present. First, because there wasn't time to take any measurements; secondly, because it was so placed that we couldn't take any photographs, and thirdly, because I hope that before long there will be some special news about this particular engine. So if the Editor approves, I shall give details of the Marshall later on.

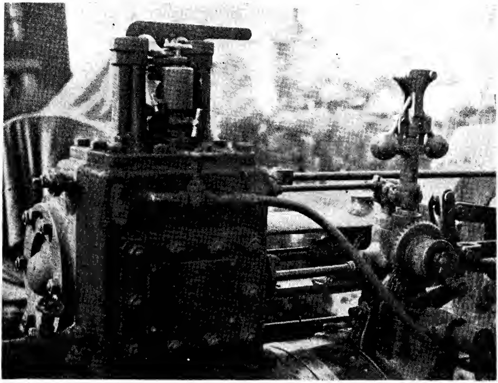


Photo No. 4—Cylinder-block and governor of No. 1407, showing lubricator and safety-valve. Linkage between governor and steam-chest may be seen. Note that valve-rod is guided by a bearing in the governor support

Steering-wheel: 17 in. diameter, 5 spokes.
Brake operating wheel: 13 in. diameter, 6 spokes. (Why the difference, one wonders?)
Hornplates are $\frac{5}{8}$ in. thick, and distance between them is $32\frac{1}{2}$ in.; thus firebox is also $32\frac{1}{2}$ in. wide and boiler ditto diameter, with lagging $1\frac{3}{4}$ in. thick.
Bolting flange at chimney foot: 13 in. diameter.
Width of engine over hind wheels: 7 ft. 7 in.
Width over tender: 2 ft. $10\frac{1}{2}$ in.
Thickness of plating of tender: $\frac{3}{8}$ in.
Distance between tender side and nearside hind wheel: 13 in.
Distance between tender side and offside hind wheel: $10\frac{1}{2}$ in.
Steering at offside. (No. 3251: at nearside).
Pump in cab, at offside, driven by eccentric between crank and crankshaft bearing, visible on photograph No. 3.

Epilogue

Since the above article was written, I have to report the sad news that Allchin No. 1275 is now no more. Like so many of her kind, she has been broken up for scrap.

Farewell, old-timer! You served your masters well for half-a-century and surely you could have no better epitaph than that. Let us hope that your metals, re-melted and re-born through Vulcan's alchemy, may serve mankind equally well in their future existence. Certainly they could not serve him better!

IN THE WORKSHOP

by "Duplex"

19—Machine-tool Slide Gibs and Locking Devices

THE gibs fitted to the slides of the lathe and other machine tools are for the purpose of maintaining the working faces of the slides in contact, and for taking up the wear that must necessarily arise in use.

It is customary to design the lathe slides so that the cutting pressure applied to the tool is taken on the standing face of the slide, that is to say, the working surface which is an integral part of the slide; the gib does not then take the cutting pressure, but serves to counteract any tendency of the slide to tilt as a result of the thrust exerted either by the tool or by the feed mechanism.

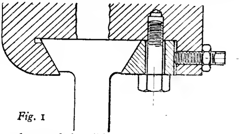


Fig. 1

This is the ideal arrangement which comes into force during the majority of lathe operations comprising sliding and facing, but when boring or back-facing, the direction of the thrust is reversed and falls on the gibs of the top-slide and saddle in the former operation, and on the cross-slide gib in the latter; although, when boring, it is usual to lock the top-slide to gain rigidity and to eliminate any error due to the reversal of thrust.

As the saddle has to take the thrust in either direction across the line of the lathe bed, it will usually be found that its gib is of robust construction and is very firmly secured in place, besides being kept up to its work by large diameter adjusting screws, or by means of a long taper cotter. The abutment shoulder behind the gib carries the adjusting screws and should be of rigid construction, and preferably, formed integrally with the sole-plate of the saddle.

The thrust exerted by the tool normally falls well within the length of the cross-slide, so that the gib is then well able to withstand the direct pressure resulting from left-hand screw cutting or traversing in that direction.

Apart from the large gibs with a taper adjusting cotter fitted to the slides of precision lathes, the commonly-used forms are the gib-piece and the gib-strip, as they may be termed.

The Gib-piece

The gib-piece, of which an example is shown in Fig. 1, consists of a rectangular bar, with an inclined working face machined to fit against either the corresponding face on the slide base or the shear of the lathe bed, as the case may be.

The gib-piece shown in the drawing is rather narrower than is generally used, and a broader bolting face in contact with the slide would overcome any tendency for the gib to tip, as in the example shown in Fig. 2.

As will be seen, the upper face of the gib-piece is held firmly to the under surface of the slide by means of screws, and the holes through which these screws pass are slotted to allow adjustments to be made. The two working surfaces are accurately hand-scraped so that they bed together without any tendency to rock. The gib is carried forward, when being adjusted, by means of the adjusting screws shown in the drawing; these screws are fitted with lock-nuts to maintain their setting. In the case of long slides, increased freedom of working and greater accuracy in operation will be obtained if the centre portion of the gib-piece is relieved as shown in Fig. 2, but when in use this depressed area must not, of course, be allowed to travel beyond the end of the slide with which the gib mates. Although in the drawing a deep relief, as is sometimes used, is shown, it will usually be sufficient to form the relief with the aid of the scraper.

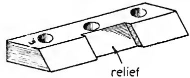


Fig. 2

The Gib-strip

Formerly, gib-pieces were used generally in the slides of all machine tools, and this is still the case in precision lathes, but the gib-strip, as illustrated in Fig. 3A, is now gaining in popularity, due in part, no doubt, to the lesser cost of manufacture and fitting. Nevertheless, when correctly fitted, the gib-strip will give satisfactory service, even in heavily stressed slides such as those of the ram of a shaping machine.

Although a gib of rectangular form in section is shown in the drawing, if a broader strip with bevelled edges is fitted, contact will be made over almost the whole of the working surfaces.

Adjusting Screws

The gib-strip is usually adjusted by means of grub-screws with conical points which engage with corresponding depressions drilled in the

strip. These screws are, therefore, intended to serve the double purpose of adjusting the strip and constraining it endwise against the frictional thrust of the moving slide.

In the past, in some lathes standard Whitworth screws have been used in this situation, but adjustment will be facilitated if screws of finer pitch are used for this purpose.

It is not uncommon to find that these screws have no lock-nuts, although if lock-nuts are fitted, as shown in Fig. 3B, there is a greater chance of the adjustment of the slide remaining set.

When a lock-nut is fitted, it is essential that its seating should be machined with a pin drill or a

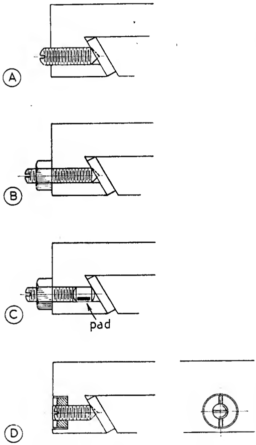


Fig. 3

spot-facing cutter, so that as the nut is tightened the screw is not displaced, and the nut can seat correctly.

When fitting the adjusting screws, a pressure-pad with rounded ends can, if preferred, be fitted as an alternative to pointing the ends of the screws. This arrangement is shown in Fig. 3C, and it will be clear that in this case no end location is provided for the strip, but this omission can be made good in a way which will be described later.

Admittedly, the appearance of an outstanding adjusting screw and lock-nut may be a little unsightly and may, when fitted to the cross-slide, even restrict the movement of the tailstock when it has to be brought close to the saddle. This can be overcome by fitting slotted collars to the screws, as shown in Fig. 3D, which illustrates the form of locking collar, but not the type of gib or screw, fitted to some well-known machine tools.

On the rare occasions that adjustments have to be made, the collar is turned with a two-lipped claw spanner, while the adjusting screw is set with a screwdriver.

Tenon Gibs

Where the tailstock is aligned by means of a tenon sliding between the shears of the lathe bed, inaccurate location will arise when the tenon becomes worn, as in time it will, and no longer fits closely against the guide-faces of the bed. Fig. 4 illustrates the method adopted by Messrs.

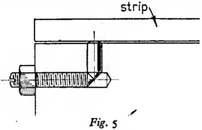


Fig. 5

Myford to adjust the fit of the tailstock tenon in the guide-ways of the lathe bed. It will be seen that a gib-piece is secured to the tailstock sole-plate with two fixing screws, and this gib can be set by means of the adjusting screws provided. This adjustment can be made when the tailstock is moved backwards and the tenon is partly disengaged from its bearing between the bed shears.

To facilitate the adjustment of a gib-piece of this type, which was not readily accessible for setting, the writers used the design illustrated in Fig. 5.

Here, as will be seen, the gib-piece or strip is pressed into contact with its mating surface by means of a plunger having its inner end formed to an included angle of 90 deg. The plunger is moved outwards by an adjusting screw with its point also machined to an angle of 90 deg., and when the adjustment of the gib has been correctly set, the screw is locked by means of a nut or screwed collar as in the previous examples.

This arrangmeent has the advantage that the gib can be adjusted while the sliding member is in place between its guide-faces, and in the case of a tailstock, for example, the tenon gib can be set as the tailstock is moved into different positions along the bed. This method of gib adjustment has its limitations, of course, and a gib so fitted should not be subjected to any great strain.

In a lathe owned by the writers, the top-slide revolved for taper turning on a graduated base casting bolted to the cross-slide. This base

member was located by means of a tenon fitting into one of the T-slots machined in the cross-slide. Unfortunately, this tenon was not a good fit in the T-slots, and this meant that there was no definite zero position of the fixed base from which to set the top-slide for taper turning. It was decided, therefore, to scrape in the pressure faces of the T-slots, that is to say, those nearer to the operator, and then to provide a means of maintaining the tenon in contact with these surfaces.

locking-screws are withdrawn, the correct working adjustment of the slide is immediately restored.

Slackness in the slides can be readily demonstrated by mounting the test indicator in the tool-post with its button in contact with a piece of rod held in the chuck; then twist the saddle in the horizontal plane with the two hands, and any play present will be shown on the dial of the indicator.

After checking and, if necessary, adjusting the saddle gib, repeat the procedure with the cross-slide and then with the top-slide.

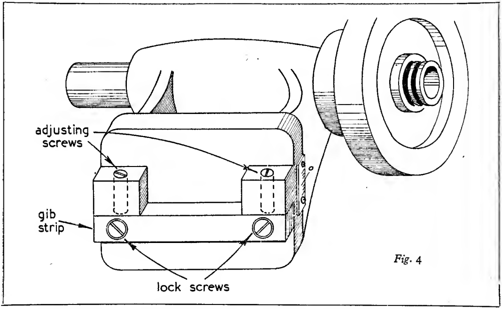


Fig. 4

The method adopted was similar to that illustrated in Fig. 5, but no gib-piece was used, and the plungers fitted to the tenon were forced against the wall of the T-slot, by tightening the adjusting screws, when the base of the top-slide was in place on the cross-slide.

This arrangement was found to be quite satisfactory in use, and there was, of course, no wear on the plungers, as the parts were stationary and not moving as in the case of a slide.

Adjusting the Gibs

It is a mistake to adjust the gibs fitted to the slides and saddle too closely, for if the movement of the slides is made too stiff, extra work is thrown on the feed-screw and feed-nut, and also on the thrust faces, with the result that all these parts will become needlessly worn.

There are occasions, however, when the slides may have to be tightened more than normal, as a purely temporary measure, to prevent the tool snatching and riding on the work; as for example, when flycutting, and the feed is applied to the work in the same direction as the rotation of the tool. For this purpose, the slide should be tightened by means of the locking-screws, as will be explained later, and the normal setting of the gib should not be upset. In this way, the adjustment of the gib is not lost and, when the

To gain rigidity during turning operations, the top-slide should be set somewhat stiffly; except when turning tapers, it usually has but limited use.

When tightening the adjusting screws of a gib-strip, be careful not to tighten those bearing on a part of the strip unsupported by the opposing working face, otherwise the gib may be bent.

A Check

It would seem to be unwise to accept the adjustment of the slide-gibs without making a preliminary check; a friend recently sought our advice, as he found that in a new lathe delivered to him the depth of cut bore but little relation to the reading of the cross-slide index. The dial test indicator was, therefore, clamped in the tool-post and brought into contact with the lathe chuck; as the indicator hand moved over a range of 20 thousandths of an inch, when the saddle was twisted with the hands, his trouble was easily explained and put right. Unfortunately, this was not his only trouble, but an account of these and their correction must wait until another time.

(*To be continued*)